present some points which I do not think have been generally observed.

Aquatic plants at the bottoms of ponds give off oxygen gas, and marsh gas is emitted from decaying vegetable matter. These two sources of supply will, to some extent, account for the entanglement of bubbles in ice on a pond surface, but only to a very small extent, and may be left out of consideration in dealing with the development of air-bubbles in ice. This takes place independently of any extraneous source of supply other than atmospheric air, and may be as well seen in a glass or earthenware vessel as over a weedy pond surface.

The following facts must be noticed :—

(1) Ice over deep water invariably contains fewer bubbles of included air and gas than ice formed over shallow water, and probably from this cause ice obtained from over deep water is more durable for storage than ice obtained from shallow pools.

(2) The upper or surface portion of a coating of ice invariably contains less included air than its under or lower portion, and this is more obvious in ice formed over shallow than in that over deep water. In each case there is a fairly regular gradation in the quantity of entangled air, increasing from the surface downwards. I ascertained that the included air from the upper surface (*a*, Fig. 1) of a thin coat of ice was scarcely appreciable in quantity, and one pound weight from its lower surface (*b*, Fig. 1) contained 0·08 of a cubic inch of entangled air.

Fig. 1.

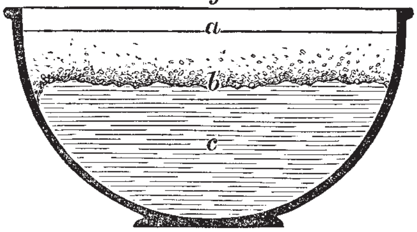
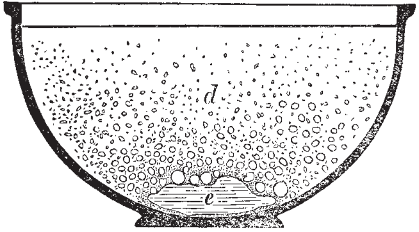


Fig. 2.



(3) There is more included air in ice formed over water in a small vessel (Fig. 1) than in ice formed over a large body of water.

(4) There is more included air (weight for weight of ice) in an entirely frozen mass of ice (Fig. 2, *d*) than in surface ice from a partly frozen vessel of water. In an entirely frozen mass (Fig. 2, *d*) 1 pound of ice contained 0·59 cubic inch of included air; and surface-ice (*a*, *b*, Fig. 1), over unfrozen water, one pound weight contained 0·15 cubic inch.

(5) In freezing separately the water from which the first frozen coat of ice had been removed (Fig. 1, *c*), the ice contained a much larger proportion of included air (0·89 cubic inch) than either the surface ice (Fig. 1, *a*, *b*) or the ice obtained from entirely freezing a body of water (Fig. 2, *d*).

(6) On re-freezing water which had been frozen and thawed, there was but a very slight further release of air, which had been almost entirely released in the first freezing : one pound of the second ice contained but 0·005 cubic inch of air.

(7) In completely freezing a vessel of water (Fig. 2), not only does the entangled air increase in quantity downwards, but at the base of the frozen mass occurs a large air-cavity (*e*, Fig. 2).

All these facts, and the results of the experiments, seem to point to the fact that, in the process of freezing, the elimination of the air and gases in solution is taking place in two directions: (1) a part of the air is taken into solution by the *un*frozen water as it is progressively rejected by the thickening coat of ice; and (2), a part of it is extruded as bubbles of air, which become entangled in the ice.

If each stratum of ice eliminated the whole of its own proportion of air in solution in the gaseous form, the bubbles would be distributed with fair regularity throughout the collective mass, but their progressive increase in a descending direction exactly agrees with the continuous surcharging of the underlying unfrozen water with the air in solution rejected by the ice above, till, at the end of the freezing process of the mass, the remnant is extruded as one large bubble (Fig. 2, *e*) at its base.

The rejection of the air into continued solution would seem to take precedence of its extrusion in the gaseous form, and would go on as long as there was a sufficient body of adjacent water in a condition to receive it; but the gradual surcharging of a limited body of water with the rejected air is necessarily accompanied by its progressively increased extrusion in the gaseous form.

The comparative absence of air-bubbles in ice over deep water is accounted for by the fact of there being a sufficient body of adjacent water in a condition to receive the rejected air into solution in preference to its extrusion as gas.

To briefly recapitulate the experimental results:—(1) In a thin ice-coating, the upper or surface half contains barely a trace of eliminated air, whilst its under or bottom half contained 0·08 cubic inch of air in each pound of ice. (2) A surface coating of ice 1½ inch thick contained 0·15 cubic inch of air in each pound weight, whilst an entirely frozen mass contained 0·59 cubic inch of air in each pound weight. (3) The freezing of a limited body of water which had been first frozen over and the surface ice removed points still more strikingly to the concentration of air in solution; for this contained 0·89 cubic inch of air in each pound weight, compared with 0·15 cubic inch in surface ice, and 0·59 cubic inch in an entirely frozen mass.

The water employed in these experiments was from the East Surrey Waterworks. GEORGE MAW

NOTES

THE following notice of motion has been given by Mr. Howell, M.P. :—"To call the attention of the House to the subject of technical education, and to move the following resolution :—'That, in the opinion of this House, it is essential to the maintenance and development of our manufacturing and agricultural industries, in view of the rapidly increasing competition of other nations, both in home markets and abroad; and in consequence of the almost universal abandonment of the system of apprenticeship; that our national scheme of education should be so widened as to bring technical instruction, the teaching of the natural sciences, and manual training, within the reach of the working classes throughout the country.'"

IT is stated that in consequence of the financial difficulties of the Bristol College, and lack of endowments, the salaries of all the Professors will be reduced by the Council, and some Chairs are to be abolished. The course pursued by the Council has given rise to much correspondence in the local papers during the past month. It is earnestly to be hoped that circumstances may yet be found to cause the Council to reconsider their position, and that a course so diastrous to the College—an institution which, in spite of its insecure position, has done excellent educational work—and to the town itself, may yet be averted. Is Bristol so flourishing that the citizens can afford to neglect the only true foundation for prosperous trade and commerce at the present time, when we are trying to compete in the markets of the world with men more highly trained than ourselves?

THE Guthrie Memorial Fund, which will shortly be closed, has now nearly reached the sum of 1400*l*. As we explained some time ago, Prof. Guthrie was too exclusively devoted to teaching and scientific research to be able to make adequate provision for his family. The object of the fund is to place his children as nearly as possible in the position they would have occupied but for his untimely death; and subscribers have been glad to have this opportunity of expressing their appreciation of his personal character and scientific labours.

WE are glad to learn that the University Extension Scheme, which has led to such excellent results in England, is likely to be tried in Scotland. The question has been for some time under the consideration of the University Court of Glasgow, and now the matter has been taken in hand by some energetic University men in Edinburgh. The proposal is that the available lecturing power of the Scottish Universities shall be united, so that while any town would naturally in the first place be supplied as far as possible from the nearest University, any desired course might be drawn from a more distant one. It is hoped that in the larger towns Extension Colleges may be established. These institutions might be made permanent by means of small endowments, or towns might secure them as centres of regular teaching for a certain number of years by subscribing a few hundred pounds to make up the deficit from fees.

DR. LEUTHNER, of Vienna, author of a remarkable memoir on the Odontolabini, a subdivision of the Coleopterous family Lucanidæ, published in the Zoological Society's Transactions in 1885, will shortly leave Europe on a collecting expedition to South Arabia and Socotra, where much work remains to be done, notwithstanding several recent excursions to the same district. Dr. Leuthner's expedition is of a private nature, but he has the full support of the Austro-Hungarian Government, and a free passage in their ships.

PROF. G. SÉE has recently published a new book, concerning diet in disease ("Du Régime alimentaire: Traitement hygiénique des Malades"). M. Sée, although he has never studied physiological questions in a special manner, always writes useful books, being familiar with English and German, and very well posted in all foreign experiments and work. The most interesting part of his book, from a physiological point of view, is that in which he discusses the question of foods and their constituents. Criticising the food-ration of the French army, he says that too much bread is allowed, and too little meat.

THE volume of the *Indian Antiquary* for the past year contains a most interesting series of papers by Mr. H. G. M. Murray-Aynsley, under the modest title, "Discursive Contributions towards the Comparative Study of Asiatic Symbolism." They commence in the March number, and, with the exception of the issues for June and July, are, continued consecutively down to, and including, the November number, and are not yet completed. One feature of special value to the European student is the method of illustration adopted. The plates are numerous, and beautifully executed, and a large number describe objects collected by the writer himself in Northern India, which have probably never before been seen by the majority of Western scholars. It is to be hoped that Mr. Murray-Aynsley will ultimately collect these papers into a volume; at present we can do no more than barely indicate the outlines of their contents. His chief object is to make a collection of facts bearing upon the subject of customs and symbols, and, after a general introduction, a chapter is devoted to each of the following divisions:—(1) Sun and cup (or moon) symbols; (2) sun-worship; (3) the *Svastika*, or emblem of fire; (4) stones worshipped in India, and their counterparts in Scandinavia and other parts of Europe; (5) the land of departed souls; (6) the trees which have been held sacred in the East and in Europe; (7) snake-worship; (8) amulets and charms; (9) the evil eye; (10) the wild huntsman of Northern Europe and his possible Asiatic origin; (11) Eastern architecture compared with certain old churches and houses in Norway; (12) Asiatic symbolism in Spain. While this may give a notion of the general contents of these papers, it gives none whatever of the mass of facts collected from different sources, principally by the author himself in India and Cashmere. The coloured illustrations of the *Svastika* symbol, showing the wide area over which it is employed, are very interesting. In addition to many others given, the author might well have added that it is almost universal in this country as a bordering to the commoner kinds of linoleum and other floor-cloths, the manufacturers having probably borrowed it from the designs on Central Asian carpets and rugs.

AN important addition has just been made to the Zoological Society's Collection in the Regent's Park, in the shape of three fine specimens of the sea-lion or eared seal of the Auckland Islands (*Otaria hookeri*). These animals, originally four in number, one having been lost during the transit home, were captured in the Auckland Islands, which lie in the Antarctic Ocean, some 900 miles south of Tasmania, by Capt. John Fairchild, master of the New Zealand Government steamer *Hinemoa*, and were sent to London in the steamship *Tongariro* by the Hon. W. J. M. Larnach, C.M.G., Minister of Marine of New Zealand, as a present to the Zoological Society. The Zoological Society's menagerie already contained specimens of the sea-lion of the Falkland Islands (*Otaria jubata*), and of the Cape sea-lion (*Otaria pusilla*), but no example of the present rarer species has been previously brought alive to Europe. There are, however, stuffed specimens of this animal in the Museum of Natural History in the Jardin des Plantes, Paris.

IN the Report of the Fish and Game Commissioners of Massachusetts for 1886, there is an interesting paper by Mr. George Dimmock on certain fish-destroying insects in the United States. The largest of them, and the most dangerous to fishes, are those which belong to the family called Belostomidæ. They are provided with powerful fore-legs, and strong, somewhat oar shaped hind-legs for swimming; and, when full-grown, they have vigorous wings, and are capable of long-sustained flight. In seizing upon fishes or other small animals, they grasp their prey with their fore-feet, holding it firmly in their claws. Then they pierce it with their beak or proboscis, and suck its blood. They are strongly attracted by the electric light, and Mr. Dimmock suggests that it might be used as a means of destroying them, as it would be easy to contrive a trap that would retain them when they fall after striking the glass. An illuminated trap beneath the surface of the water might, he thinks, be more effective than one above the surface, for the Belostomidæ do not often leave the water, apparently, except when they quit it for the purpose of migration.

THE United States Fish Commission print in one of their recent Bulletins an excellent report by Mrs. Emma Metcalf Beckley, Curator of the Hawaiian National Museum, on "Hawaiian Fishing Implements and Methods of Fishing." The writer gives some curious details about octopus-fishing. The smaller kinds of octopus, which live in shallow water, are caught by women, who do their work with remarkable skill. They can tell whether an octopus is in a hole whose entrance is no larger than a silver dollar, and, plunging their spears in, they invariably draw one out. The larger kinds of octopus, which are always found in deep water, are caught by men with cowries, generally of the Mauritiana, but sometimes of the tiger species. An octopus will not rise to a large-spotted or ugly cowry, so the fishermen have to take care that the spots on the back of the shell are very small and red, breaking through a reddish-brown ground. Cowries with suitable spots, but objectionable otherwise, are slightly steamed over a fire of sugar-cane husks, a process which gives them the desired hue. The fisherman, having arrived at his fishing-grounds, first chews and spits on the water a mouthful of candle-nut meat, which renders the water glassy and clear; he then drops the shell with hook and line into the water, and swings it over a place likely to be inhabited by an octopus. The moment an octopus perceives a cowry, it shoots an arm out and clasps the shell. If the shell is of the attractive kind, one arm after the other comes out, and finally the whole body of the octopus is withdrawn from the hole and attaches itself to the cowry, which it closely hugs, curling itself all around it. The creature remains very quiet while being rapidly drawn up through the water. Just as it reaches the surface, the fisherman pulls the string so as to bring its head against the edge of the canoe, and it is killed by a blow from a club which is struck between the eyes. This must be done rapidly, before the animal has time to become alarmed; for if it lets go the cowry, it becomes a dangerous antagonist, and there is risk of the fisherman being squeezed to death. The cutting off of one or more of its eight arms does not affect the rest in the least.

WE have received *Studies in Microscopical Science*, vol. iv. No. 6, Sections 1-4. The text of the first three sections relates to botanical, animal, and pathological histology; that of the fourth to marine Algæ. The plates are very delicately executed.

WE have also received the seventh, eighth, and ninth parts of the Transactions of the Yorkshire Naturalists' Union. Among the contents is an interesting presidential address on "The Fathers of Yorkshire Botany," delivered, in 1884, by Mr. J. G. Baker, F.R.S., President of the Yorkshire Naturalists' Union.

THE Selborne Society intend to issue letters, from time to time, on its objects and work. They will be written by members who have a special knowledge of the subjects discussed. The first of the series, which has just been published, is on the feeding and protection of wild birds in winter. The next will be on the Wild Birds Protection Acts of 1880 and 1881, and their bearing on bird-catching and bird-nesting during the close season. Other letters will follow on birds, trees, and plants, and it may be hoped that the scheme will be of considerable service in disseminating a knowledge of practical natural history.

THE French Government has purchased the hillock of Sansan (Département du Gers), which is famous for its richness in fossil animal remains. M. E. Lartet was the first discoverer of this palæontological treasure. M. Filhol, the naturalist, has recently examined the hillock; he was commissioned by the Professor of Palæontology at the Jardin des Plantes, Paris. This gentleman, supported by M. Cavaré, found fossil remains not only of Mastodons, Macrotheria, Chalicotheria, &c., but also of bears, stags, dogs, and cats. Noteworthy are some stags' horns, with two main branches, or so-called Dicroceri. All these fossils will be deposited in a museum to be built at Sansan, and will be described in a catalogue by M. Filhol.

PROF. W. J. TSINGER, at Moscow, is busily engaged in preparing his bulky work on the flora of Middle Russia, including the floras of the fifteen central provinces.

A LEARNED Society called the Società Italiana Asiatica has been formed in Italy for the investigation of Eastern languages and archæology. Prof. Amari has been elected Honorary President. The Society has obtained the collaboration of the best Italian Orientalists, and has nominated twenty-four foreign honorary members, among whom are Profs. Böhtlingk, Max Müller, Roth, Fleischer, Renan, Weber, Whitney, Rawlinson, Maspero, Legge, Brugsch, and Friedrich Müller.

THE Anthropological Society of Bombay, the establishment of which less than a year ago has been noticed in these columns, has already over 300 members, and has published the first number of its Transactions. Mr. Tyrrell Leith, the founder of the Society, has a paper on divination by Hazirat among the Indian Mussulmans; Dr. Dymock writes on the hairy man of Burmah, and Indian necromancy; Dr. Weir, on sacrifice in India as a means of preventing epidemics; and Dr. Basu, on embalming in Ancient India, and on Nisi, the night demon. There are other papers, but this list is sufficient to show the activity and utility of the new Society.

THE author of the paper on "Mexican Codices and Graven Inscriptions" inadvertently referred to in a Note last week as "Mr. Z. Nuttall," is "Mrs. Zelia Nuttall," one of two American ladies elected to the honorary position of "Special Assistant" of the Peabody Museum of Archæology, Cambridge, Mass. The paper in question was communicated to the American Association for the Advancement of Science in August last, when Mrs. Zelia Nuttall announced her discovery of "determinative signs," forming a key to Aztec phonetic manuscript records and graven inscriptions, and presented, in support of her statements, comparative tables of phonetic signs for inspection to the Section of Anthropology. Mrs. Zelia Nuttall has recently contributed to the *American Journal of Archæology* an account of the terra-cotta heads of Teotihuacan. These little clay heads, of most varied types, are frequently found in the vicinity of the great pyramids at San Juan Teotihuacan, about 30 miles north-east of the city of Mexico. They had been generally considered the work of different races of people, inhabitants of the valley of Mexico at successive periods, and were therefore held to be of considerable antiquity. Mrs. Zelia Nuttall's comparative researches prove them to be of Aztec workmanship, and thus of more modern date. She found that several of the most typical head-dresses modelled in clay were identical with those worn by Aztecs of different social grades, as depicted in Spanish chronicles at the time of the conquest of Mexico. Mrs. Nuttall adduces satisfactory proofs that these little clay heads were the portrait-models of dead persons adorned with the insignia of their rank. Attached to bodies of perishable materials, they served as effigies of the dead, and were placed on the coffers or jars containing the cremated remains, which were kept in the household dwellings of the relatives. Food and wine were offered before them, incense was burnt, and, at certain prescribed recurrent ceremonials, animals were sacrified in their honour.

WE notice, in the last *Bulletin* of the St. Petersburg Academy of Sciences, a valuable preliminary sketch of the avifauna of the western spurs of the Pamir plateau and its northern border-ridge, the Altai Mountains, by V. Bianchi. The birds were collected by M. Grum-Grzimailo, and the collection includes 136 species, which probably represent about one-third of the species inhabiting the region. With the exception of nine species, the same were found by Dr. Severtzoff in Bokhara, and described in the *Journal of Ornithology*, 1875; and only five species are not yet known in Russian Turkestan. It thus appears that the avifauna of the Western Pamir is very similar to that of the region situated on the other slope of the Kashgar-daban Mountains. Nearly a hundred species out of the above-mentioned 136 are also found in the Western Himalayas, but this last region has a number of endemic species which give it its special character. The poverty of the fauna of the Pamir plateau is obviously the consequence of its valleys being at a height of no less than 10,000 feet above the sea-level. The presence of the following species in the region will be interesting to zoo-geographers :—*Saxicola finschi*, *Cyanecula leucocyana*, *Herbivocula neglecta*, *Acanthopneuste nitida*, *Trochalopterum lineatum*, *Microcichla scouleri*, *Cyanistes flavipectus*, *Rhodopechys sanguinea*, and *Nisaëtus fasciatus*.

IN the *Zeitschrift für Instrumentenkunde* for September 1886 there is a paper entitled "Ueber eine Methode zur Messung kleiner Winkeldifferenzen," by Herr Hugo Langner, of Breslau. It describes a method of measuring the angle between two plane reflecting surfaces when it is nearly an aliquot part of two right angles, by measuring the difference between the required angle and the nearest aliquot part. It is known that in looking into the angle formed by two such surfaces the image of any small object lying between them will be seen repeated. If the angle be nearly $\frac{\pi}{n}$ $\left(\text{say } \frac{\pi}{n} - \delta\right)$, then when δ is positive, there will be a certain portion of the space between the two reflecting planes where both *n*th images can be seen, but if δ be negative, there will be a space where neither can be seen. If, again, for a small object a scale be substituted, then when δ is + two images will be seen, and a certain portion of the scale will be seen in both images; while if δ be − there will be a portion which is in neither image, and this superfluous or defective portion will be a measure of δ. Herr Langner proposes to place in front of the angle, and at a considerable distance from it, a scale bent to a cylinder whose axis is the intersection of the reflecting planes. Observing with a telescope looking into the angle, the position where a division of one image of the scale falls on the other image can be read, and, if the radius of the scale be known, the angle subtended by the relative displacement of the images, and thence the difference between the approximate and real values of the angle between the reflecting surfaces found. Herr Langner gives as an example the determination of the angle of a right angled prism of glass, of which a single determination would seem not to be liable to a greater error than 4″ or 5″. And he suggests that the method might be applied advantageously to determine the movements of a magnet by determining from time to time the changes of the angle between a mirror fixed to the needle, and one which is absolutely fixed, and to measure small variations of an angle in other cases.

THE little marine laboratory connected with the Johns Hopkins University is almost as old as the great laboratory at Naples. A sketch of its history is presented in a recent report by Dr. W. K. Brooks, Director of the Marine Laboratory, to the President of the Johns Hopkins University. In 1878 a small appropriation was made by the Trustees of the University to enable a party of biologists to spend a few weeks at the seashore in the study of marine zoology; and the scientific results of the season's work were printed in an illustrated volume, the cost of publishing which was borne by some citizens of Baltimore. The next year the appropriation was renewed, and in 1880 the Trustees voted that the laboratory should be continued for three years more, providing 4500 dollars for outfit and an annual sum of 1000 dollars for current expenses. The scheme worked so well that at the end of three years the institution was maintained. After an examination of all the available localities, the town of Beaufort, N.C., about 400 miles south of Baltimore, was selected as the site for the laboratory; and a vacant house, suitable for the accommodation of a small party, was found, and rented as a laboratory and lodgings. This house has been occupied during five seasons, and much good work has been done in it. During the season of 1886 a party of seven students went, under the direction of Dr. Brooks, to carry on zoological investigation in the Bahama Islands.

THE additions to the Zoological Society's Gardens during the past week include three Hooker's Sea Lions (*Otaria hookeri* ♂ ♂ ♀) from New Zealand, presented by the Government of New Zealand; a Blue Penguin (*Eudyptula minor*) from New Zealand, presented by Dr. Bernard Lawson; a Domestic Sheep (*Ovis aries* ♂, four-horned var.) from Cashmere, presented by Major Roland Poole; two Wood Hares (*Lepus sylvaticus*) from North America, presented by Mr. Walter Ingram, F.Z.S.; a Blotched Genet (*Genetta tigrina*) from South Africa, presented by Capt. J. Robinson; a Grey Ichneumon (*Herpestes griseus*) from India, presented by Mr. Stanlake Batson; a Spotted-billed Duck (*Anas pœcilorhyncha*) from India, received in exchange; three Lions (*Felis leo*), an Axis Deer (*Cervus axis* ♂) born in the Gardens.

OUR ASTRONOMICAL COLUMN

THE NEW ALGOL-TYPE VARIABLE.—Mr. Chandler has been able (Gould's *Astronomical Journal*, No. 150) to secure some further observations of this star, which, so far as they go, tend to confirm the hypothesis of a period of about three days. Minima were observed on January 2 and 11, but these were inconclusive as to the period. The star was, however, observed on January 12, between 17h. 15h. and 18h. 5m., to be apparently of its normal maximum brilliancy, whereas the first rough elements formed would have given a minimum at 17h. 50m., had the period been 1·4992d. or 0·7496d. Further observations are much desired. It unfortunately happens, from the star's period being very closely commensurable with the mean solar day, that further observations of minima will be scarcely possible in Northern Europe or Eastern North America for many months.

GORE'S VARIABLE NEAR χ^1 ORIONIS.—Dr. G. Müller, from a series of observations extending from 1886 November 9 to 1887 January 8, finds that the star attained its maximum on 1886 December 12. Assuming the light-curve the same at the preceding maximum, it will have been at its brightest on 1885 December 13, so that the period will be about 364 days.

THE SOUTHERN COMET.—The following telegram has been received from Cape Town, from which it appears that the new southern comet resembles that of 1880 I. in its orbit as well as in its physical appearance :—"Cape Town, January 26.—No condensation observable; riband of light 35° long, narrowing towards sun, position narrowest part near as can observe, January 22·317 G.M.T., R.A. = 322° 31′, N.P.D. = 135° 48′. The orbit presents a close resemblance to Comet 1880 I. Perihelion, January 11, noon." The comet is rapidly diminishing in brightness, and it is already invisible to the naked eye.

A SHORT METHOD FOR COMPUTING REFRACTIONS.—In the *Astronomische Nachrichten*, No. 2768, Mr. Schaeberle, of the Ann Arbor Observatory, explains a short and convenient method for computing astronomical refractions between 0° and 45° zenith distance. Let k and k_0 be respectively the true and mean refractions when $z = 45°$, then for any other zenith distance less than 45° the approximate true and mean refractions would be given respectively by

$$r = k \tan z, \qquad r_0 = k_0 \tan z,$$

from which is derived

$$r = r_0 - \frac{k_0 - k}{k_0} r_0,$$

an expression which, for the assigned limits of zenith distance, will give the true refraction within 0″·01, provided the true value of r_0 is used in the second member of the equation. The factor $\frac{k_0 - k}{k_0}$ will, however, be constant only so long as the barometer and thermometer readings remain unchanged. To allow for changes in these quantities, let F_1 and F_2 denote respectively the values of these factors at the times T_1 and T_2;